

In the Claims

Please amend the claims of the Application as follows:

1. (Currently Amended) A method of creating entanglement between first and second atomic ensembles, comprising:

~~generating pulses of light in a pulsed source of light, wherein each pulse of light includes at least one photon;~~ propagating a first pulse of light generated in said pulsed source of light into a the first atomic ensemble having a first collective excitation state, wherein photons in said first pulse of light have an energy that can excite the first atomic ensemble to the said first collective excitation state so as to generate first photons;

propagating a second pulse of light generated in said pulsed source of light into a the second atomic ensemble having a second collective excitation state, wherein photons in said second pulse of light have an energy that can excite the second atomic ensemble to the said second collective excitation state so as to generate second photons;

~~receiving from said first ensemble and said second ensemble~~ interfering the first and second photons at an interferer ~~for interfering light pulses substantially only photons resulting from generation of said first collective excitation and said second collective excitation; and~~

~~receiving detecting from said interferer the interfered photons at a first single photon detector and second single photon detector light said~~ so as to establish entanglement between the first and second atomic ensembles.

2. (Currently Amended) The method of claim 1 further comprising detecting the interfered photons with a first or second photon detector and controlling photon detection of said first single photon detector and said second single photon detector ~~with a photo detector controller.~~

3. (Currently Amended) The method of claim 1 further comprising preventing photons not resulting from the generation of collective excitations in one of said first atomic ensemble and said second atomic ensemble from reaching said interferer by arranging a first filter with a first filter disposed in a first optical path between said first atomic ensemble and said interferer, and a second filter in a second optical path between said second atomic ensemble and said interferer.

4. (Canceled) The method of claim 1 further comprising preventing photons not resulting from generation of collective excitations from reaching said interferer with a second filter disposed between said second ensemble and said interferer forming the first and second light pulses from a single pulse of light.
5. (Currently Amended) The method of claim 1 wherein ~~an incident photon in a pulse of light generated by said source of light and transmitted into either said first ensemble or said second ensemble has~~ the first and second light pulses each have a substantial probability of ~~interacting with the ensemble to generate a generating collective excitation~~ excitations in the first and second atomic ensembles, respectively in the ensemble.
6. (Currently Amended) The method of claim 1 including forming each atomic ensemble from one of ~~wherein said ensemble comprises~~ solid matter, gaseous matter and liquid matter.
7. (Canceled) The method of claim 1 wherein said ensemble comprises gaseous matter.
8. (Canceled) The method of claim 1 wherein said ensemble comprises liquid matter.
9. (Currently Amended) The method of claim 1 wherein generating the first and second photons involves ~~said collective excitation of a photon in said pulses of light interacting with one of the ensembles to generate one of the collective excitations defines a Stokes process.~~
10. (Currently Amended) The method of claim 1 wherein ~~each of the~~ first and second atomic ensembles have substantially identical collective excitation energies.
11. (Currently Amended) The method of claim 1 wherein said first ~~ensemble~~ and said second ~~ensemble~~ atomic ensembles comprise alkali atoms.
12. (Currently Amended) The method of claim 1 wherein said first ~~ensemble~~ and said second atomic ensembles ~~ensemble~~ comprise Cesium atoms.

13. (Currently Amended) The method of claim 12 wherein ~~the a density of~~ Cesium atoms in each one of said first ~~ensemble~~ and said second ~~ensemble~~ atomic ensembles has a density of is between 1 and 100 atoms per cubic micron ~~micro-meter~~.

14. (Canceled) The method of claim 1 wherein said preventing photons not resulting from generation of collective excitations in one of said first ensemble and said second ensemble from reaching said interferer comprises a wavelength sensitive first filter disposed between said first ensemble and said interferer.

15. (Currently Amended) The method of claim 1 including synchronizing the first and second light pulses with ~~wherein said source comprises a synchronizer for synchronizing transmission from said source of two pulses.~~

16. (Currently Amended) The method of claim 1 including generating the first and second light pulses with ~~wherein said source comprises a laser.~~

17. (Currently Amended) The method of claim 1 including generating the first and second light pulses with ~~wherein said source comprises a flash lamp.~~

18. (Currently Amended) The method of claim 1 wherein said first ensemble and said second ensemble contain only atoms ~~molecules each of which has a collective excitation.~~

19. (Currently Amended) The method of claim 1 further comprising ceasing generating ~~pulses of~~ first and second light pulses in said pulsed source of light when one of said two single photon detectors detects a photon ~~pulse~~.

20. (Currently Amended) The method of claim 1 further comprising entangling a third atomic ensemble optically coupled to the first atomic ensemble with a fourth atomic ensemble optically coupled to the second atomic ensemble, ~~each having a collective excitation state, wherein photons in said first pulse of light have an energy that can excite said collective excitation state.~~

21. (Currently Amended) The method of claim 20 further comprising entangling said first and second atomic ensembles with said third and fourth atomic ensembles.

22. (Currently Amended) The method of claim 21 wherein said entangling comprises detecting a photon ~~pulse~~ propagated through a second ~~beam splitter~~ interferer using to one of a third single photon detector and a fourth single photon detector.

23. (Currently Amended) The method of claim 22 further comprising filtering light pulses transmitted towards said second interferer ~~beam splitter~~.

24. (Currently Amended) The method of claim 21 further comprising entangling said third and fourth atomic ensembles with fifth and sixth atomic ensembles.

25. (Currently Amended) The method of claim 1 further comprising repeated applications of the ~~steps~~ acts defined in claim 1 with a number of additional sets of atomic ensembles to provide long distance quantum communication over a communication distance via entanglement between remote ones of the atomic ensembles in a manner such that that number of additional atomic ensembles scales ~~which resources only scale~~ polynomially with the communication distance.

26. (Currently Amended) The method of claim 1 further comprising repeated applications of the ~~steps~~ acts defined in Claim 1 with a number of additional sets of atomic ensembles to provide long distance entanglement generation over a communication distance ~~comprising in~~ which the number of atomic ensembles scales ~~resources only scale~~ polynomially with the communication distance.

27. (Currently Amended) A system comprising:

a ~~pulsed source of light~~ source for generating pulses of light, ~~wherein each pulse of light includes at least one photon;~~

a first atomic ensemble ~~into~~ in which a first pulse of light from the light source creates ~~generated in said pulsed source of light can propagate, said first ensemble having a first~~ collective excitation state, ~~wherein photons in said first pulse of light have an energy that can~~

~~excite said first collective excitation that generates first photons;~~

a second atomic ensemble ~~into~~ in which a second pulse of light from the light source creates ~~generated in said pulsed source of light can propagate, said second ensemble having a~~ second collective excitation state, ~~wherein photons in said second pulse of light have an~~ energy that can ~~excite to said second collective excitation that generates second photons;~~

~~receiving from said at-~~

an interferer ~~for interfering~~ arranged so as to interfere first and second photons in light ~~pulses received from~~ respectively generated in the first ensemble and said second atomic ensembles ~~resulting from generation of said first collective excitation and said second-~~ collective excitation; and

a ~~first single photon detector and second single photon detector for~~ detectors arranged so as to detect the interfered first and second photons so as to create entanglement between the first and second atomic ensembles. ~~receiving light pulses from said interferer propagated-~~ to said interferer from said first ensemble and said second ensemble.

28. (Currently Amended) The system of claim 27 further comprising a ~~photo-detector~~ controller operably coupled to the first and second single photon detectors and adapted to ~~control for controlling photon detection of said first single photon detector and said second-~~ single photon detector.

29. (Currently Amended) The system of claim 27 further comprising a first filter disposed between said first atomic ensemble and said interferer for preventing photons not ~~resulting-~~ from generation of collective excitations generated in one of said first atomic ensemble and said second ensemble from reaching said interferer.

30. (Currently Amended) The system of claim 29 ~~27~~ further comprising a second filter disposed between said second atomic ensemble and said interferer for preventing photons not ~~resulting from generation of collective excitations~~ generated in said second atomic ensemble from reaching said interferer.

31. (Currently Amended) The system of claim 27 wherein ~~an incident photon in a pulse of~~ light generated by said source of light and transmitted into either said first ensemble or said

~~second ensemble has a~~ the first and second pulses of light have a substantial probability of interacting with the first and second atomic ensembles, respectively, so as ~~ensemble~~ to generate a collective excitation in the respective atomic ensembles ~~ensemble~~.

32. (Currently Amended) The system of claim 27 wherein said atomic ensemble comprises solid matter.

33. (Currently Amended) The system of claim 27 wherein said atomic ensemble comprises gaseous matter.

34. (Currently Amended) The system of claim 27 wherein said atomic ensemble comprises liquid matter.

35. (Currently Amended) The system of claim 27 wherein said first and second photons are generated by ~~collective excitation of a photon in said pulses of light interacting with one of the ensembles to generate one of the collective excitations defines a Stokes process in the~~ respective first and second atomic ensembles.

36. (Currently Amended) The system of claim 27 wherein ~~each of the~~ first and second atomic ensembles have substantially identical collective excitation energies.

37. (Currently Amended) The system of claim 27 wherein said first atomic ensemble and said second atomic ensemble each comprises alkali atoms.

38. (Currently Amended) The system of claim 27 wherein said first atomic ensemble and said second atomic ensemble each comprises Cesium atoms.

39. (Currently Amended) The system of claim 38 wherein ~~a density of~~ the Cesium atoms ~~in each one of said first ensemble and said second ensemble~~ have a density of is between 1 and 100 atoms per cubic micron ~~micro-meter~~.

40. (Currently Amended) The system of claim 27 further comprising first and second a-

wavelength sensitive filters respectively arranged first filter between in a first optical path between said interferer and said first atomic ensemble and a second optical path between said interferer and said second atomic ensemble.

41. (Currently Amended) The system of claim 27 including wherein said source comprises a synchronizer operably coupled to the light source and adapted to for synchronizing synchronize the first and second light transmission from said source of two pulses.

42. (Currently Amended) The system of claim 27 wherein said light source comprises a laser.

43. (Currenty Amended) The system of claim 27 wherein said light source comprises a flash lamp.

44. (Currently Amended) The system of claim 27 wherein said first atomic ensemble and said second atomic ensemble contain molecules ~~each of which has~~ having substantially the same a collective excitation energy.

45. (Currently Amended) The system of claim 27 further comprising a controller adapted to cause the light source to cease ~~means for ceasing~~ generating first and second light pulses of ~~light in said pulsed source of light when~~ the interfered first and second photons is detected ~~one of said detectors detects a pulse.~~

46. (Currently Amended) The system of claim 27 further comprising means for entangling a third atomic ensemble with a fourth atomic ensemble, each atomic ensemble having a collective excitation state, wherein photons in said first and second ~~pulse of light~~ pulses have an energy that can excite said collective excitation state.

47. (Currently Amended) The system of claim 46 further comprising means for entangling said first and second atomic ensembles with said third and fourth atomic ensembles.

48. (Currently Amended) The system of claim 47 further including a second interferer optically coupled to third and fourth single photon detectors, wherein said entangling

comprises detecting interfered photons pulse propagated through a second beam splitter the second interferer to one of a the third single photon detector and a fourth single photon detector detectors.

49. (Currently Amended) The system of claim 48 further comprising a filters for filtering light pulses transmitted towards said second beam splitter interferer.

50. (Currently Amended) The system of claim 47 27 further comprising a plurality of atomic ensembles, a plurality of interferers and a plurality of pairs of single photon detectors for adapted to create effective maximally entanglement (EME) entangling said third and fourth ensembles with fifth and sixth between two remotely located atomic ensembles.

51. (Currently Amended) ~~The~~ A long distance quantum communication system of ~~according to claim 27 further~~ comprising means for a number of repeated sequences applications of the steps defined in claim 1 of the system of claim 27 adapted to effectuate with additional sets of ensembles to provide long distance quantum communication between remotely located atomic ensembles separated by a communication distance, in which the number of repeated sequences scales resources only scale polynomially with the communication distance.

52. (Currently Amended) ~~The~~ A long distance entanglement system of ~~according to claim 27 further comprising means for~~ a number of repeated sequences of the system of claim 27 adapted to effectuate applications of the steps defined in Claim 1 with additional sets of ensembles to provide long distance entanglement generation between remotely located atomic ensembles separated by a communication distance, comprising in which resources only scale the number of repeated sequences scales polynomially with the communication distance.

53. (Currently Amended) In a system in which a first atomic ensemble pair L1,R1 is entangled due to excitation of photon generated collective excitations, and a second atomic ensemble pair L2, R2 is entangled due to excitation of photon generated collective excitation, a method comprising:

receiving single photon detection signals from one of a first, second, third, and fourth

single photon detectors; and

~~identifying if establishing entanglement between atomic~~ ensemble pair L1,R1 is-
~~entangled with~~ and ensemble pair L2, R2 by detecting a photon in any one of said first,
second, third, and fourth single photon detectors.

54. (Currently Amended) The method of claim 53 wherein atomic ensembles L1 and R1 are
remotely located, and further comprising transmitting information between atomic ensembles
L1 and R1 once atomic ensemble pair L1,R1 is entangled with atomic ensemble pair L2, R2.

55. (Original) In a system in which ensemble pair L1, R1 is entangled due to excitation of
photon generated collective excitations and ensemble pair L2, R2 is entangled due to
excitation of photon generated collective excitation, a method comprising:

receiving single photon detection signals from one of a first, second, third, and fourth
single photon detectors;

generating a control signal based upon said detection signals;

transmitting said control signals to a secondary control system;

controlling generation of an optical pulse based upon said control signals, wherein said
optical pulse is transmitted to ensemble pair R1,L1; and

identifying if an ensemble I1 is entangled with ensemble pair R1,L1 by detecting a
photon in either the first single photon detector or the second single photon detector.

56. (Original) The method of claim 55 further comprising transmitting information once
ensemble II entangled with ensemble pair R1, L1.

57 (New) A long distance communication system based on quantum teleportation,
comprising:

a secondary controller comprising a light source and a synchronizer for generating
synchronized first and second light pulses;

first and second atomic ensembles R1 and R2 optically coupled to the secondary
controller via first and second optical paths and adapted to emit Stokes light pulses in
response to being irradiated with said first and second light pulses, respectively;

third and fourth atomic ensembles L1 and L2 respectively optically coupled to first

and second atomic ensembles R1 and L2, wherein L1 and R1 are entangled and L2 and R2 are entangled;

fifth and sixth atomic ensembles I1 and I2 respectively optically coupled to atomic ensembles L1 and L2 by respective first and second interferers adapted to interfere Stokes light pulses from atomic ensembles L1 and I1, and from atomic ensembles L2 and I2, respectively, wherein atomic ensembles L1, L2 constitute a logical qubit (qubit A), atomic ensembles I1, I2 constitute an input qubit (qubit E) of an unknown state, and atomic ensembles R1, R2 represent a qubit B;

first and second single photon detectors optically coupled to the first interferer, and second and third single photon detectors optically coupled to the second interferer, the first through fourth single photon detectors adapted to detect interfered light pulses and generated a click in the form of first through fourth photodetector signals, respectively;

a photodetector control unit adapted to receive the first through fourth photodetector signals and generated therefrom a control signal that is transmitted to the secondary controller; and

wherein the photodetector control unit obtains an outcome of a Bell-measurement on qubits A and E via a first or second photodetector signal and a third or fourth photodetector signal, and in response thereto generates the control signal that causes the secondary controller to emit first and/or second light pulses in order to replicate the unknown state of qubit E in qubit B.